

09/326,925  
BUR.038



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*#1/Declaration*

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

Andrews et al.

Serial No.: 09/326,925

Group Art Unit: 2813

Filed: June 7, 1999

Examiner: D. Blum

For: LOW COST SHALLOW TRENCH ISOLATION USING NON-CONFORMAL  
DIELECTRIC MATERIAL

Honorable Assistant Commissioner of Patents  
Washington, D.C. 20231

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**DECLARATION UNDER 37 C.F.R. §1.131**

Sir:

Comes now the Declarant, Howard Landis, and states and avers the following:

- (1) I am a co-inventor of claims 1-23 of the above-referenced patent application and a co-inventor of the subject matter described and claimed therein.
- (2) Prior to June 2, 1999, I had completed my invention as described and claimed in the subject application in the United States. Specifically; prior to June 2, 1999, having earlier conceived of the idea of a process to form planarized shallow trench isolation (STI) structures using a non-conformal high-density plasma (HDP) oxide deposition, including inter alia, providing a semiconductor substrate with raised and lowered regions with substantially vertical and horizontal surfaces, said vertical surfaces having a predetermined height, depositing filler material over the horizontal surfaces to at least a thickness equal to the predetermined height so as to provide raised and lowered regions of filler material, separating adjacent sections of the raised and lowered regions of filler material by at least a gap of exposed underlying material; and selectively removing the raised regions of filler

material, I acted with due diligence to reduce the invention to practice from just before June 2, 1999 to June 7, 1999, the U.S. filing date of the present Application. This is evidenced by the following Exhibits which are attached hereto and incorporated by reference herein (note that any dates deleted from Exhibits A-D are prior to June 2, 1999):

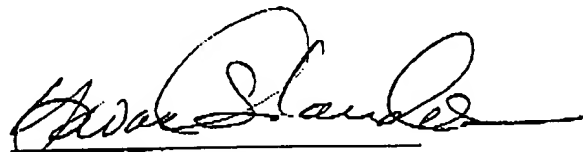
- a) Exhibit A is a copy of an invention disclosure which was forwarded to the patent practitioner.
- b) Exhibit B is a copy of a letter from me to the patent practitioner, in which I forwarded my comments regarding a draft application to the patent practitioner.
- c) Exhibit C is a copy of a letter from the patent practitioner to Shaw-Ning Mei, a co-inventor, in which the patent practitioner forwarded a revised draft of the Application.
- d) Exhibit D is a copy of a letter from the patent practitioner, in which a final draft of the Application was forwarded to the co-inventors for signatures.

(3) The above Exhibits clearly demonstrate due diligence from just before June 2, 1999 to June 7, 1999 (the filing date of this Application).

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.



HOWARD LANDIS

March 19, 2001  
DATE



Title of Invention (Short & Descriptive) Maskless STI Planarization with HDP Oxide					
Disclosure No. BU898-0158		Functional Manager Brent Anderson		Receiving Date	
				Receiving Time 17:35:53	
Patent Attorney Jerry Walter			Evaluator Randy Mann		Evaluation Area 03
Inventor Landis, Howard S		Emp. Serial 522839	Div./Dept. 29/M63V	Bldg. or Zip 972-C	Location BURLINGTON
				Tel. Number 446-8329	
Area Code 03	Electronic Address H LANDIS at IBMUSM01		Manager's Name Dennis Bouldin		Manager's Electronic Address DBOULDI at IBMUSM01

Table 1. Critical Dates Information

Date invention workable:	00/00/98
Used or Planned for product:	N
If so, Product Name?	
Release?	
Announce Date?	
Public Demonstration or Use:	N
If so, When?	
Where?	
Disclosed to Non-IBMers:	N
If so, When?	
Where?	
CDA in place?	
Use in Manufacturing:	N
If so, When?	
Where?	
Product Name?	

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Exhibit A

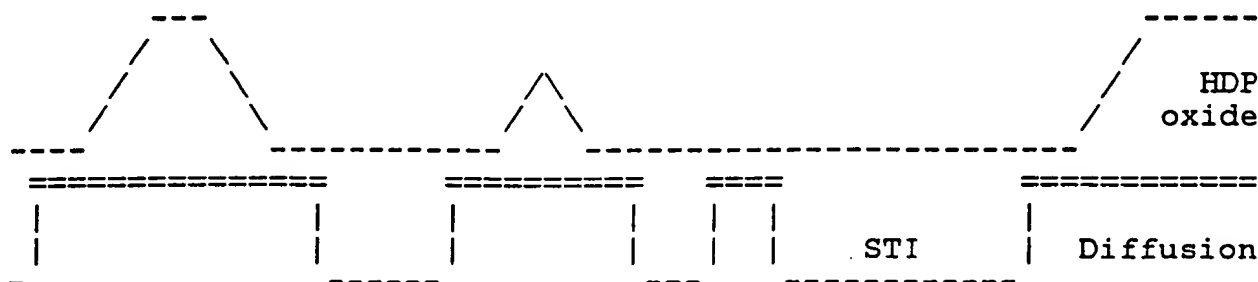
## Problem

STI planarization by AB, No-AB, Petri or M-Petri is expensive and can introduce significant non-uniformity into the final STI thickness.

## Solution

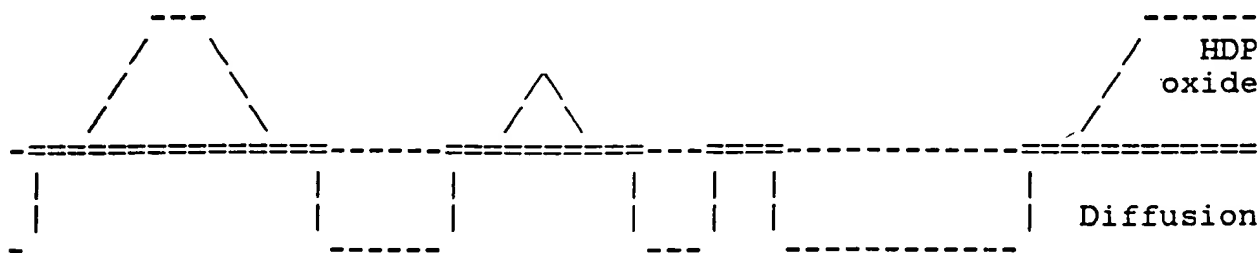
HDP oxide is often used when excellent gap-fill is required. An obvious feature of HDP oxide is the very non-conformal nature of the as-deposited film.

Figure 1. As-deposited HDP oxide



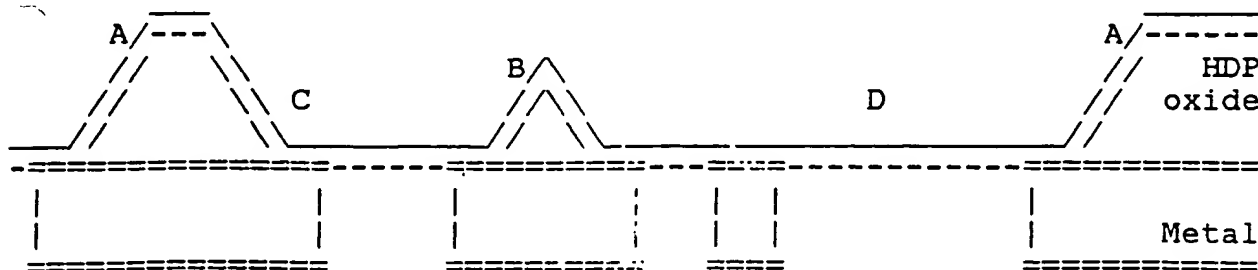
By taking advantage of the reproducibly-small amount of oxide covering the corner of every diffusion, it is possible to effect ILD planarization using three short dry-process steps (which can be clustered with HDP oxide dep) and two wet-dips.

### Step 1. Isotropic or directional oxide etch



It is important that the nitride pad gets exposed at the corner of every diffusion. The HDP oxide cannot be anywhere recessed so far that the silicon sidewall is exposed.

### Step 2. Deposit conformal film, such as PECVD silicon nitride



Step 3. Sputter-etch the conformal film, so as to expose HDP oxide at every corner A or B, but to not completely remove the conformal film at any inside-corner C or flat region D.

1. Wide diffusions may be covered by residual conformal film at the end of step 3. These bits of material will be undercut during the isotropic oxide etch in step 4, and will lift off. Detached pieces will be effectively removed by the isotropic etch in step 5.
2. Very-wide diffusions may be covered by wide-enough sections of residual conformal film so as to exceed the distance that the isotropic etch in step 4 can undercut. Such diffusions would need to be identified in each design, and be subjected to a very small amount of "cheesing", as is practiced for damascene copper lines in CMOS-7S0 and CMOS-7SF. For an IIF-based wet etch in step 4, the cheese shapes could be made small enough and widely-dispersed enough to have no practical effect on the layout or behavior of the STI.

**I am not sure.**



IBM Microelectronics  
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Essex Junction, VT 05452

Howard Landis  
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Wednesday,

David C. Oren  
Law Offices of McGinn & Gibb, P.C.  
1701 Clarendon Boulevard, Suite 100  
Arlington, VA 22209

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MAR 21 2002  
TC 2800 MAIL ROOM

Re: New U.S. Patent Application  
Title: LOW COST SHALLOW TRENCH ISOLATION USING  
NON-CONFORMAL DIELECTRIC MATERIAL  
IBM Docket: BU9-98-0225  
Your Ref: BUR.038

Dear Mr. Oren:

Enclosed is a copy of your first draft of the above-referenced patent application, to which I have added some comments and clarification, particularly related to the second embodiment. I have taken the liberty of redrawing a number of the figures, in the hope that they might help you understand the salient features of the invention. I have also added a few figures to better communicate some of the background concepts related to HDP deposition and sputter-etching. I have saved my edits in on the accompanying 3.5" diskette, for your convenience.

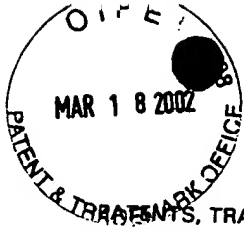
Thank you for your diligent efforts in this matter. I look forward to hearing from you soon.

Sincerely yours,

Howard Landis

Exhibit B





LAW OFFICES OF  
**McGINN & GIBB, P.C.**

A PROFESSIONAL LIMITED LIABILITY COMPANY  
PATENTS, TRADEMARKS, COPYRIGHTS, AND INTELLECTUAL PROPERTY LAW  
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SEAN M. MCGINN  
FREDERICK W. GIBB, III  
DAVID C. OREN

VIA EXPRESS MAIL

Mr. Shaw-Ning Mei  
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Mail Stop M15  
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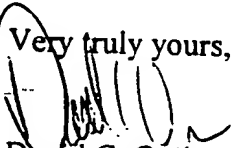
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Re: New U.S. Patent Application  
Title: LOW COST SHALLOW TRENCH ISOLATION USING  
NON-CONFORMAL DIELECTRIC MATERIAL  
IBM Docket: BU9-98-225  
Our Ref: BUR.038

Dear Mr. Mei:

Enclosed is a revised draft of the above-referenced patent application which includes all of your suggestions and includes Howard Landis' suggestions. Please review the application and return any written comments to me preferably no later than . so that we can finalize the application for filing. Please also ensure that the application is acceptable to your co-inventors, namely, Edward Vishnesky, Bao Hwang and John Andrews. I am separately contacting Mr. Landis for his approval.

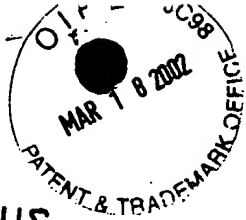
Thank you for your cooperation.

Very truly yours,  
  
David C. Oren

DCO/amc  
Enclosures

Exhibit C

EJ692928308US



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A PROFESSIONAL LIMITED LIABILITY COMPANY  
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**VIA EXPRESS MAIL**

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Re: New Patent Application  
Title: LOW COST SHALLOW TRENCH ISOLATION USING NON-  
CONFORMAL DIELECTRIC MATERIAL  
IBM Docket: BU9-98-225  
Our Ref: BUR.038

Dear Jerry:

Having received approval of the application by the inventors, enclosed is the final application and formal papers for the above-identified application. Also enclosed is a diskette with the application saved in WP 5.1/5.2, WP 6/7/8 and ASCII Dos Text, related papers saved in WP 6/7/8 and forms saved in LegalStar.

I have prepared the claims to be consistent with your instructions. Specifically, independent claim 1 corresponds to your sample claim, independent claim 9 is a broad method claim and independent claim 16 is of intermediate scope.

I have also taken this opportunity to enclose our debit note for services and disbursements in connection with the preparation of this application. Thank you for allowing us to be of service to you.

Very truly yours,

  
David C. Oren

DCO/amc  
Enclosures

Exhibit D